3.5 BIOLOGICAL RESOURCES – AQUATIC RESOURCES

This section describes the fish and invertebrates associated with the aquatic environment that may be affected by the Dutch Slough Restoration Project and Related Projects. Analysis will focus both on impacts to the aquatic habitats and how fish and prey utilization of those habitats would be affected, both directly and indirectly. Specific habitats will include all shallow water habitats, including open water, subtidal, and intertidal, associated with the restoration and park projects sites and vicinity.

3.5.1 Affected Environment

The San Francisco Estuary (Estuary) can be divided into five separate regions: The Sacramento-San Joaquin Delta (the Delta), Suisun Bay, North (San Pablo) Bay, Central Bay, and South Bay, each of which exhibits somewhat different hydrological conditions determined by its position relative to marine and freshwater sources (Conomos 1979). The Dutch Slough Restoration Project lies within the legal boundary of the Delta, close to its western edge, which extends to the Sacramento River to the north, and the San Joaquin River to the south. The Delta is a vast expanse of various wetland and shallow water habitats with western limits several miles upstream of the main river confluence near Suisun Bay. The triangular-shaped landscape is incised by a network of channels and sloughs, often circumnavigating diked islands used for agricultural purposes. Tidal effects are significant throughout the delta, creating a maze of interconnected freshwater tidal marshes which historically dominated landscape habitat, comprising nearly 90 percent of the total land space; however, this habitat is now reduced to several hundred acres in size with little connectivity. The salinity associated with the Estuary tides rarely penetrates into the Delta except during times of low flow (i.e. summer and early fall).

The combined discharge of both rivers is high, receiving runoff from two interior watersheds totaling 63,000 square miles which accounts for 90 percent of the total freshwater entering the San Francisco Bay. Each river, however, has a unique hydrographic signature in terms of flow and sediment load, reflecting in part human alterations and use (i.e., dams and water diversions). As a result of these and other human induced changes, pelagic fish species in the delta, including longfin smelt (*Spirinchus thaleichthys)*, threadfin shad (*Dorosoma petenense*), striped bass (*Morone saxatilis*), and delta smelt (*Hypomesus transpacificus*) are currently in decline. One species, the delta smelt, is listed as threatened under both the Federal and the California Endangered Species Acts.

The serious decline in certain fish species, including the threatened delta smelt, and their associated food organisms, is commonly referred to as Pelagic Organism Decline (POD). As part of continuing POD studies, scientists have recently documented a serious and unexpected decline (approximately 90%) in young delta smelt produced this season. The location of the young fish is an even greater concern; they were found in the channels that are within the sphere of influence of the South Delta Diversions, including the State and Federal Water Projects' pumping plants. Areas of toxic waters also have been observed in the nursery areas of young smelt. Some of the other declining species, including striped bass, are exotic species that have historically occurred at very high density in the estuary.

Dutch Slough Area Setting

Dutch Slough is located in the western delta, an area of low salinity and historically high biological productivity. Several conspicuous features of the western delta include the confluence of the Sacramento and San Joaquin River and the Low Salinity Zone, an interface between the freshwater source flows and the furthest reach of the tidal influence where dense patches of zooplankton and larval fish are naturally entrained in the water column. This west delta area is documented to be an important rearing area for many of the Delta's estuarine-dependent fish, which utilize the increased turbidity in this area to avoid visual predators (Dege and Brown 2004, Kimmerer 2002, Nobriga et al. 2005).

The large embayment called Big Break lies just west of Dutch Slough. Big Break is a former asparagus farm where levees breached in 1928 due to excessive rainfall, resulted in flooding of the diked lands with flows from the San Joaquin River, Dutch Slough, and a remnant waterway connecting from the east. Big Break now consists of mostly open-water habitat, lined by the leveed agricultural land of Jersey Island to the north and East Bay Regional Park District public shoreline access to the south. A small patch of high quality tidal marsh exists along the southern edge of Big Break; however, non-natural hydrological conditions have helped fuel the growth of the invasive Brazilian waterweed (*Egeria densa*), which is often too dense to pass through by boat.

The terminus of Marsh Creek runs parallel to the western border of the Emerson Parcel. Totaling 30 miles in length, Marsh Creek is a significant source of freshwater to the local system of Big Break and vicinity draining 128 square miles of agricultural and urban land of Contra Costa County foothills. Marsh Creek has been significantly impacted by human activity: it features a dam and reservoir in its upper reaches, while its lower reach has been highly channelized for flood control purposes. Development of the Marsh Creek watershed has led to reduced natural flows and compromised water quality due to urban and agricultural runoff, wastewater treatment plant discharges, and historic mercury mining activities (Cain and Robins 2003).

FISH

The distribution and abundance of estuarine organisms are often affected by both physical and biological processes. Inland fish species common in the western delta are often classified by their tolerances to salinity and temperature and how their life history strategies have evolved to utilize the delta's various habitats (i.e. timing in estuary, feeding type - benthic (bottom) or pelagic (open water)). A high percentage of the fish community assemblage in the Delta consists of non-native species that compete with native species for resources. Restoration of natural processes has the potential to lessen the establishment of non-native species and subsequently assist native populations (Marchetti et al. 2004).

In the tidal freshwater system of the Delta, temperature and freshwater flows are important non-biotic factors that influence fish distribution and composition, and are often cited as the critical component for the life history strategies of many of the native species (Feyrer and Healy 2003). For example, Grimaldo et al. (2004) and Simenstad et al. (2000) reported peak abundances for native fish species in February and March (i.e. period of high river flow and lower temperatures), with a later second peak in summer for non-native fish species reflective of warm-water and low flow conditions.

FRESHWATER TIDAL MARSH HABITAT

A tidal freshwater marsh often consists of a mosaic of different shallow water habitats, populated by a heterogeneous composition of plants spatially distributed relative to tidal hydrology. It has been widely documented that tidal marsh systems provide essential habitats for an array of aquatic animals, supporting particularly high abundances of fish and aquatic invertebrates. Tidal marsh systems include extensive networks of small vegetated channels and sloughs dispersed through the marsh plain which provide access to critical foraging grounds. In the Delta, channel and slough networks within tidal freshwater marshes can range from limited to more extensive, and generally channels with inverted elevations around MLLW (mean lower low water) tend to become full of tule (*Schoenoplectus acutus)* vegetation. The very small extent of remaining tidal marsh in the Delta, especially large marshes, makes it difficult to generalize their characteristics. Channel habitat characteristics, including width, maximum water depth, sediment composition and profiles all have an effect on species composition and utilization patterns (Williams and Zedler 1999). For example, fish abundance has been positively correlated with marsh channel edge, suggesting larger channel systems could provide more complexity and heterogeneity of habitats. Fish growth can be used as a measure of marsh function as it incorporates multivariate environmental factors often too complex to separate. Madon et al. (2001) found that killifish could double their daily food intake if access to the marsh plain was available; high densities of larval insect prey forms in shallow, emergent marsh habitat suggest a benefit for fish growth as well (see Grimaldo et al. 2004, Kneib 2003).

Nursery value of the tidal marsh is high for fish, providing suitable substrate, hydrologic conditions, and critical geomorphic features that enhance refuge for breeding and spawning adults and young (Minello et al. 2003). Many fish species use the inland channel tributaries to lay eggs and rear young before emigrating back to open waters. Marsh-plain habitats have been documented to be critical to the successful recruitment of fish species as refuge from predators and as forage grounds. These shallow-water habitats are only available when the water surface rises higher than the channel sides, such as when flooded during high river discharge or during high spring tides.

FOOD WEB STRUCTURE

The nutritional complexity of freshwater tidal marshes is supported by a robust food-web structure consisting of terrestrial insects, planktonic invertebrates, benthic macroinvertebrates, and detritus; all of which form the base of available prey for larval and juvenile fish. Aquatic invertebrates associated with habitats found in tidal marsh systems are often more diverse in composition, and are susceptible to the same hydrologic forcing mechanisms that affect their distribution and abundance.

Benthic invertebrates that reside on or near the bottom of channels contribute significantly to the production of fish and macroinvertebrates. Simenstad et al. (2000) found the larvae and benthic pupae of chironomids, a terrestrial insect that completes its juvenile life cycle in water, to be abundant in the diet of fishes utilizing tidal marshes. Crustacean zooplankton such as copepods associated with water column and shallow water habitats were also dominant prey taxa. Other significant sources of prey include fall-out insects associated with the water surface, which are often consumed by Chinook salmon juveniles. Aquatic invertebrates produced within tidal marshes also have indirect benefits at a regional scale, acting as important vectors for the transfer of energy from these nearshore environments to deeper waters and beyond.

FISH COMPOSITION AND ABUNDANCE

The Delta has a well documented history of abundant biological resources rich in aquatic animal species, both within the larger delta channels and tidal sloughs and marsh systems supporting large numbers of migrating salmon and steelhead returning to spawn in the tributaries of the upper Sacramento and San Joaquin rivers. The recent literature and long term monitoring programs have identified almost 100 fish species that use the Estuary either seasonally as rearing grounds to forage on prey taxa, or as year round residents, completing their entire life history within the Estuary (Marchetti et al. 2004 and Moyle 2002).

Long term monitoring collections of fish and macroinvertebrates of the Estuary have been conducted by several state and federal regulatory and governmental agencies primarily as part of the Interagency Ecological Program (IEP), with broad objectives to describe the general trends in the distribution, abundance, and community composition of both native and alien species. These agencies include California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (USFWS), Department of Water Resources (DWR), and U.S. Bureau of Reclamation. Other studies on this topic include Orsi (1999), Matern et al. (2002), and Wang (1986). These field efforts often employ trawl methods that bias results towards specimens vulnerable to those gear types and, more importantly, towards species inhabiting the larger deeper channel habitats often associated with higher flows and open water. Abundance and composition data are publicly available (see http://www.iep.ca.gov).

More recently, investigators have relocated their efforts to address questions seeking to understand how fish utilize shallow water and near-shore habitats of tidally affected fresh and saltwater marshes (see Grimaldo 2004, Nobriga et al. 2005, IRWM [www.irwm.org], Simenstad et al. 2000).

A diversity of fish species are expected to penetrate into marshes and mudflats via the tidal channels, and occupy the system at low tides and water within channels (Kneib and Wagner 1994). Fish assemblages can also be stratified by water depth, with juveniles of many species maintaining their position in relatively shallow water, including smaller, shallow channels within the marsh system, and adults and larger juveniles found only in larger, deeper channels. Common bottom-dwelling species such as gobies and sculpins may be found throughout the tidal channel systems. Open water species such as inland silverside (*Menidia beryllina*), splittail (*Pogonichthys macrolepidotus*) and juvenile Chinook salmon (*Oncorhynchus tshawytscha*) will move dynamically in and out of the channels, although specific patterns of movement with tide stage is generally unknown. Evidence from other regions suggests that juvenile Chinook salmon may penetrate into lower order channels in marshes as long as the channels are unvegetated. Epibenthic species such as tule perch (*Hysterocarpus traskii*) and bluegill (*Lepomis macrochirus*) will also occupy the channels, but perhaps in greater densities concentrated among emergent submerged aquatic vegetation (SAV) and floating aquatic vegetation (FAV). Larger, more active predators, such as the non-indigenous juvenile striped bass and largemouth bass (*Micropterus salmoides*), will likely move in and out of the larger channels with tidal fluctuation. It is thought by many that tidal wetlands may increase the survival of juvenile fish by offering rearing and refuge habitat, thus leading to increased production of adults (Brown 2003).

CURRENT FISH HABITAT

The existing on-site fish habitat is limited to non-tidal freshwater marsh habitat that occurs in perennially flooded or ponded, shallow (less than three feet deep) depressions and channels throughout the interior of the diked areas of the Dutch Slough Restoration Project site. Tidal freshwater marsh habitat occurs along the exterior edge of the diked areas, predominantly located along unarmored (i.e., no riprap) levees, decrepit levees, narrow marsh or creek areas, and on in-channel islands in Dutch Slough. An extensive and high quality stand of tidal marsh exists in the abandoned channel of the former mouth of Marsh Creek along the north edge of the Emerson parcel. Some tidal marsh also occurs along Big Break's southeastern corner, directly across Marsh Creek from the Emerson Parcel.

SPECIES OF CONCERN TO THE DUTCH SLOUGH RESTORATION PROJECT

Table 3.5-1 lists the most common species captured from local fish population studies and reflects the possible pool of species that could utilize the Dutch Slough Restoration Project area. The table describes the general habitat needs of the species and which habitat features of the Dutch Slough Restoration Project (open water, low marsh, mid marsh, and high marsh) the species is likely to utilize.

Table 3.5-1: Sacramento – San Joaquin Estuary Fishes that Could Utilize the Dutch Slough Restoration Project Area

		Project Microhabitat			Status I = Introduced N = Native
Species	General Habitat	Open water	Low to Mid Marsh	Mid to High Marsh	
Inland silverside, *Menidia beryllina*	Shallow fresh waters in the Delta and tributaries. Transient planktivores that feed on zooplankton and utilize marsh opportunistically. Common with salmon and splittail.	Yes	Yes	Yes	I
Threadfin shad, *Dorosoma petenense*	Well lighted surface waters. Open, warm water.	Yes	Yes	In channels	I
Striped bass, *Morone saxatilis*	Suisun and San Pablo Bay - water column oriented. Will enter marsh to forage. Larvae associated with warm water temperatures and lower outflow.	Yes	Yes	In channels	I
Yellowfin goby, *Acanthogobius flavimanus*	Shallow, soft bottom areas. Partially catadromous.	Yes	Yes	In channels	I
Splittail, *Pogonichthys macrolepidotus*	Nursery resident and will occupy marsh for long durations feeding on marsh prey. High temps will limit splittail recruitment. Age-0 fish favor low velocity shallow-water habitats.	Yes	Yes	Yes	N
Redear sunfish, *Lepomis microlophus*	Deep (>2M), warm, quiet ponds, lakes and sloughs with substantial SAV.	Yes	Yes	In channels	I

Species	General Habitat	Project Microhabitat			Status I = Intro-duced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
Bluegill, *Lepomis macrochirus*	Reservoirs, warm shallow lakes, sloughs; favor aquatic plants. Opportunistic feeders, wide range of prey types. Larvae were found in shallow water as well as the open estuary; lower reaches of the Delta and Suisun Bay.	Yes	Yes	In channels	I
Threespine stickleback, *Gasterosteus aculeatus*	Shallow, weedy pools, emergent plants and over gravel, sand and mud. Pelagic, SAV associated. Prefer zooplankton prey.	No	Yes	Yes	N
Rainwater killifish, *Lucania parva*	Shallow inshore water with dense vegetation. Migrate to freshwater to breed. Abundant when flows are high and temps low.	No	Yes	Yes	I
Largemouth bass, *Micropterus salmoides*	Throughout sloughs and tributaries of the Delta. Densities and life stage dependent on SAV density. Prefers lower temperatures.	Yes	Yes	In channels	I
American shad, *Alosa sapidissima*	Anadromous adults breed in freshwater, beginning their immigration in March to May.	Yes	Yes	In channels	I
Longfin smelt, *Spirinchus thaleichthys*	Most common in the open waters of upper SFE, preferring more saline waters but capable of tolerating freshwater necessary for spawning.	Yes	Yes	No	N
Chinook Salmon, *Oncorhynchus tshawytscha* Spring Run: Federal - Threatened State - Threatened Winter Run: Federal - Endangered State - Endangered	Found along the margins of channels and shallow water habitats. Winter and spring runs. Favor open water areas and unvegetated habitats.	Yes	Yes	In channels	N
Central valley steelhead, *Oncorhynchus*	Central Valley main river systems. Spawn in small, freshwater tributaries. Juveniles remain in freshwater for several years before returning to the ocean. Main rearing habitat	Yes	Yes	In channels	N

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
mykiss irideus Federal - Threatened	is in stream/river systems.				
Tule perch, *Hysterocarpus traski*	Associated with vegetated habitats, backwaters with complex banks; epibenthic. Only resident, freshwater, native.	Yes	Yes	In channels	N
Delta smelt, *Hypomesus transpacificus* Federal - Threatened State - Threatened	Lower reaches of the SR, SJR and the Delta; preference for low salinity areas with tidal influence. Spring/Early summer individuals scattered throughout Suisun; brackish water rearing habitat.	Yes	Yes	In channels	N
Green sturgeon, *Acipsenser medirostris* Federal - Threatened	Sacramento River is the southern boundary of their range with anecdotal evidence of a San Joaquin population. Enter freshwater only to spawn. Migrate during periods of high flow and cold water. Prefer large, fast flowing channels	Rare	No	No	N
Sacramento pikeminnow, *Ptychocheleius grandis*[n]	Smaller streams and freshwater tributaries. Native piscivore related more to north delta; juveniles and adults common in the western Delta in turbid in tidal freshwater habitats.	Yes	No	No	N
Sacramento blackfish, *Orthodon microlepidotus*	Small turbid streams and sloughs with a preference for turbid, warm waters; common also in lakes and reservoirs. Spawnings occurs in shallow water within aquatic vegetation.	Yes	Yes	Yes	N
Golden shiner, *Notemigonus crysoleucas*	Warm, shallow sloughs. Beds of aquatic vegetation.	Yes	Yes	In channels	I
Bigscale logperch, *Percina macrolepida*	Slow moving, warm, clear streams. Bury in sand and gravel, but very opportunistic feeders.	Yes	Yes	In channels	I
Prickly sculpin, *Cottus asper*	Common in the Sacramento and San Joaquin rivers and estuary.	Yes	Yes	In channels	N

Species	General Habitat	Project Microhabitat			Status I = Introduced N = Native
		Open water	Low to Mid Marsh	Mid to High Marsh	
Hitch, *Lavinia exilicauda*[n]	Warm, low-elevation lakes, sloughs, and slow-moving stretches of river. Spawning in nontidal creeks. Juveniles in shallow weedy areas of nontidal creeks. Present in Marsh Creek.	Rare	Rare	Rare	N
Sacramento sucker, *Catostomus occidentalis*	Found in the open waters of the Delta and Suisun Bay. Juveniles remain in freshwater.	Rare	Rare	Rare	N
White catfish, *Ameiurus catus*	Shallow waters throughout the Delta. Stagnant or slow current habitats, including the oligohaline portion of San Pablo Bay.	Yes	Channels	In channels	I
Western mosquitofish, *Gambusia affinis*	Shallow, stagnant ponds. Prefers water with cover.	Yes	Yes	Yes	I

Delta smelt, *Hypomesus transpacificus*, is listed as threatened under both federal and state Endangered Species Acts (ESA). The delta smelt is the only smelt endemic to California and is described as the only true native estuarine species found in the Sacramento-San Joaquin Delta (Moyle and others, 1989, Wang 1986). Although historically distributed broadly from Suisun Bay through the central Delta and upstream in both the Sacramento and San Joaquin Rivers, (Moyle and others, 1989), that range is now more restricted depending upon life history stage and river discharge rates. Extensive congregations were previously documented in upper Suisun Bay and Montezuma Slough (Federal Register, 58: March 5, 1993). Due to flow manipulation, the distribution of delta smelt has more recently shifted to the Sacramento River channel (Moyle and others, 1992). Although concentrated along the northern margins of the western and central Delta, schools of delta smelt have been observed on the intake screens of the Pittsburg and Contra Costa power plants (Wang, 1986). Delta smelt spawn in shallow, fresh or slightly brackish water upstream of the mixing zone, typically in tidal portions of backwater, sloughs and channel edge-waters in the western Delta (Wang, 1986, Moyle and others, 1992). Big Break is noted as a likely rearing region for delta smelt, where appropriately brackish, shallow, protected, food-rich environments are maintained. While the Dutch Slough Restoration Project may provide benefits to delta smelt by increasing prey items, it is not likely to provide a significant increase in habitat.

Splittail, *Pogonicheilus macrolepidotus*, is listed as a species of concern under the federal ESA. Native populations are concentrated in the central and western Delta, Suisun Bay, and several of the San Pablo tributaries, particularly the Napa River, and Petaluma River (Moyle, 1976). They are most abundant in the north and west portions of the Delta, although other areas are considered to be suitable for spawning (CDFG, 1995). Because splittail spawn on flooded terrestrial vegetation in the lower reaches of rivers and the Delta, the decrease in riparian marshlands and floodable areas in recent decades has likely been a major contributor to their decline (Federal Register, 64: February 8, 1999).

Juvenile chinook salmon, *Oncorhynchus tshawytscha*, migrate and rear in the western and central Delta. The Sacramento River winter run is listed as endangered under both federal and state ESAs. The spring run is listed as threatened under both federal and state ESAs. Fall and late-fall runs are not listed but are a species of concern to both State and federal authorities. Juvenile Chinook are typically found along the margins of channels and shallow water habitats, where they feed on zooplankton (*Daphnia* spp.), epibenthic crustaceans (amphipods) and aquatic (*Chironomidae*) and surface insects (Simenstad and others, 2000). Based on the IEP survey results, the western Delta region could constitute a significant rearing area for these "ocean-type" Chinook when Delta outflows are high enough to depress the salinity regime to oligohaline conditions.

Central Valley steelhead, *Oncorhynchus mykiss irideus* are found throughout the Central Valley main river systems (Sacramento River and to a lesser extent San-Joaquin River) however densities have been critically reduced by dam construction within the major tributaries and headwaters, and currently only a winter run persists. In March of 1998, Central Valley steelhead were listed as a threatened species, reaffirmed in January of 2006.

Central valley steelhead spawn in the smaller freshwater tributaries to the main rivers during January through March when flows are high and temperatures are cool. Juveniles remain in freshwater for several years before emigrating back to the ocean for adult growth. Dam obstruction prevents adult steelhead from reaching the preferred spawning and rearing areas. Adult steelhead immigrating to spawning locales upstream will benefit indirectly from restoration efforts in the west Delta as will juveniles returning back to the ocean.

Green sturgeon, *Acipsenser medirostris* have a general southern distribution boundary in the Sacramento River with the highest densities in the Colombia River in Washington, and Klamath River, with local recordings in the Feather River and near Red Bluff. There is anecdotal support for a San Joaquin population, however the counts are markedly low and are considered uncommon. Green sturgeon enter freshwater only to spawn, between February and July during periods of high flow and cold water. In the west Delta, adults will be confined to the larger, fast flowing channels. In the San Francisco tributaries juveniles migrate back to the ocean within a year or two, spending at least 3 years at sea before returning to spawn. Adults do eat fish, but a preponderance of their diet is derived from the benthos, including crustaceans, amphipods, and mysid shrimp. The green sturgeon is listed as federally threatened.

Sacramento perch, *Archoplites interruptus,* are unique as the only native centrachid species in the Estuary. There were once broad historic distributions throughout the Central Valley common in sloughs and slow moving rivers, with additional catches in smaller creeks. Today the population is severely limited in number and individuals are captured mainly in manmade lakes and reservoirs in part due to increased competition from non-native centrarchids. Spawning occurs primarily from March to August correlated with rising water temperatures, where males actively defend nests on various bottom substrates. No Sacramento perch have been recorded in local fish monitoring efforts in the western Delta recently, however efforts by California Department of Fish and Game to reintroduce individuals have occurred in Suisun Marsh and Sherman Lake.

NONNATIVE PREDATORS OF CONCERN

Striped bass, *Morone saxitalis*, a non-native species, are abundant in this region of the Delta and are known predators of delta smelt and juvenile Chinook salmon. In addition to these predators, non-indigenous fish such as the wagasaki, or Japanese smelt (*Hypomesus nipponensis*), and inland silverside may constitute competitors with Delta smelt (Bennett et al. 1995).

Largemouth bass, *Micropterus salmoides* were introduced early in California's history as a recreational game fish where they quickly established as an aggressive predator throughout waterways in the state. Largemouth bass are abundant in warm, shallow ponds and reservoirs and prefer bed of dense aquatic vegetation. . They are voracious predators capable of feeding on a variety of prey types and sizes, but subsist mainly on fish. Individuals are capable of withstanding a wide range of temperature and can persist within local highs. Largemouth bass prefer freshwater habitats and are rarely found in salinities above 5 o/oo.Spawning events can occur as early as March and continue through June, where eggs are deposited in nests made of sand or gravel depressions constructed defended by the males species. The salinity, hydrologic conditions, and prey availability will favor success of largemouth bass in the west Delta.

Introduced sunfishes, *Lepomis* spp. (e.g., bluegill and red ear Sunfish) represent an abundant and diverse group of deep bodied, freshwater fishes, which have adapted to a varied range of habitats in the Sacramento-San Joaquin Delta. They are most common in warm, reservoirs, lakes, and ponds, but also inhabit streams and rivers where pools exist, and are highly correlated with aquatic vegetation and cover; which are a common habitat in the west Delta. Researches also identified the dominance of introduced sunfishes in Big Break, and area often choked with floating and submerged aquatic vegetation. Feeding behaviors are equally flexible, capable of preying on food items throughout the water column. Spawning generally occurs from spring to late summer, where males construct nests in the gravel beds and sand and continue to defend vigorously.

Yellowfin goby, *Acanthogobius flavimonus* are native to the shallow coastal waters Japan, Korea, and China. They were believed to have been introduced to the Estuary in 1963 via vessel ballast water and are now common throughout the waterways of California. In the Estuary yellowfin gobies are found in shallow, soft-bottomed areas within a large range of salinities, including freshwater, which adults require for breeding. Adult females spawn in fall and winter primarily in San Pablo Bay, but are regularly captured in Suisun Bay during the spring and summer. These species will be common in the project area, particulary during the spawning season. Yellowfin gobies exploit a broad array of prey items including fish, but feed heavily on amphipods and mysids.

3.5.2 Impacts and Mitigations

Significance Criteria

Criteria for determining significant impacts to aquatic organisms were based on the State CEQA Guidelines (Appendix G) and on professional judgment. The Guidelines state that the project would have a significant impact on aquatic resources if it:

A. Has a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. Fish and Wildlife Service

B. Interferes substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impedes the use of native wildlife nursery sites.

The CEQA Guidelines do not define the term *substantial* since what is considered substantial will depend on the species in question and the circumstances of individual projects. It is therefore up to the organization preparing the EIR to determine standards for the threshold of significance.

Impacts to the fish assemblage in the vicinity of project were assessed by evaluating all potential direct, indirect, temporary, and permanent impacts. The Dutch Slough Restoration Project is intended to produce tidal wetland habitat in an area that is currently diked and managed for agriculture, and thus has the potential to be a net benefit to fish. However, implementation of the Dutch Slough Restoration Project could negatively impact fish through the following mechanisms:

- Changes in water quality (See Section 3.2, Water Quality for analyses of this issue)
- Entrainment of fish in areas disconnected from the Bay-Delta
- Disturbance of substrate
- Creation of habitat that will benefit non-native invasive species at the expense of natives

Alternative 1: Minimum Fill

IMPACT 3.5.1-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES (DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS)

Potential water quality changes due to the Dutch Slough Restoration and Ironhouse projects that could impact fish and macroinvertebrates include changes in suspended sediments, dissolved oxygen (DO), temperature, and various contaminants. The significance of these water quality impacts is based on compliance with standards set forth by the RWQCB Central Valley Region Water Quality Control Plan (Basin Plan) (2004) and other supporting documents. For further information on these standards and how the Dutch Slough Restoration and Related Projects may affect water quality, see Section 3.2.

Periods of high suspended sediment concentrations can reduce respiratory efficiency in fish due to clogging and abrasion of gill filaments, thus leading to increased stress levels (Waters 1995, Kemp 1949). Increased turbidity due to suspended sediments can lead to reduced feeding efficiency for visual predators like salmon (Madej 2004). Sediment can also smother eggs, causing increased mortality thus affecting future fish stocks (Hobbs 1937). The Basin Plan states that suspended sediment concentrations should not reach levels that impair beneficial uses (such as supporting fisheries). A threshold level of 50 NTUs (units of turbidity) should not be exceeded in waters of the central Delta.

Contaminants such as petroleum products (fuels, oil, grease) used in conjunction with construction activities can be accidentally introduced into the water. These substances are known to be toxic to fish and prolonged exposure can cause morphological, behavioral, physiological, and biochemical abnormalities (Sindermann et al. 1982). The Basin Plan states that water should not contain oils, greases, waxes or other materials in concentrations that cause a nuisance, or result in a visible coating/film on the water surface or on objects in the water.

Implementation of this alternative would require re-grading, lowering, and potentially disking the existing levees surrounding the Dutch Slough Restoration Project site. Unintentional levee breaches surrounding open water management areas would have to be repaired. Also, creating the final levee breaches to allow full tidal exchange between the Dutch Slough Restoration Project area and the Bay-Delta would require excavation adjacent to and inside the waters of the Delta. The construction activities have the potential to increase suspended sediments and introduce contaminants (fuel oils, grease) in the vicinity. This impact would apply to all portions of the Dutch Slough Restoration Project. It also would apply to the Ironhouse Project because it involves grading and lowering levees adjacent to Marsh Creek. Since this disturbance could be continuous throughout the levee construction/maintenance period, and could therefore impact special status species in the immediate vicinity, the impact is considered potentially significant.

It is possible that the upstream reach of Little Dutch Slough may need to be dredged to allow full tidal drainage to adjacent marshes. This action would cause a short-term increase in suspended sediments since it involves direct disturbance of the substrate. This impact is considered to be potentially significant.

MITIGATION 3.5.1-1.1: DEVELOP A STORM WATER POLLUTION PREVENTION PLAN (SWPPP) THROUGH THE RWQCB

Prior to construction of the Dutch Slough, City of Oakley Community Park, or Ironhouse Project, the respective applicant shall obtain authorization from the RWQCB. As part of this application process, the applicant shall develop a SWPPP and identify Best Management Practices (BMPs) for controlling soil erosion and the discharge of construction-related contaminants. BMPs shall be monitored as specified in the SWPP for successful implementation. This mitigation measure shall apply to all portions of the Dutch Slough Restoration and Related Projects that involve construction activities.

MITIGATION 3.5.1-1.2: LIMIT CONSTRUCTION TO THE DRY WEATHER SEASON (JUNE – NOVEMBER)

Construction activities involving earth-moving on any of the sites in an area where material may enter or be transferred to a slough shall be limited to the April 15-October 15 dry season. This will reduce the amount of sediment and contaminants washed into the Delta from the Dutch Slough Restoration and Related Projects site by rains.

MITIGATION 3.5.1-1.3: INSTALL COFFER DAMS

Prior to levee breaching, coffer dams shall be installed around areas where the levees are to be breached to allow construction equipment to operate on both sides of the levee while greatly reducing the amount of sediments and construction contaminants reaching the Delta.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.5.1-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING PRE-BREACH WATER MANAGEMENT PERIODS (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

Low DO concentrations can be common in shallow, isolated bodies of water experiencing limited hydraulic exchange with surrounding areas. Temporary reductions in DO concentrations below an organism's tolerance level can cause undue stress, impede movement, and lead to death if conditions persist long enough. The Basin Plan states that DO concentrations in waters of the Delta should be above 5.0 mg/l.

These shallow, isolated water bodies can also experience elevated temperatures. As with DO, temporary periods of water temperatures outside an organism's tolerance range can cause undue stress, can impede movement, and can lead to death if conditions persist long enough. The Basin Plan states that the temperature of intrastate waters such as the Delta shall not be increased more than 5°F above their ambient temperature by outside input.

Most fish are capable of leaving areas where detectable water quality conditions become adverse. However, less mobile organisms such as macroinvertebrates may not be able to avoid such conditions. A decrease in macroinvertebrates could indirectly but significantly affect fish by reducing prey availability.

The Dutch Slough Restoration Project includes some pre-breach water management periods during which revegetation will be encouraged or open water maintained. Areas graded to tidal marsh plain elevations (low and mid marsh) are expected to have a relatively short water management period. Areas graded to open water are expected to have far longer water management periods, with duration dependent on open water options (discussed below).

During pre-breach water management periods, water will periodically be released from the Dutch Slough Restoration Project area during drawdown. The release of stagnant water with low DO and high temperature compared to the surrounding waters could be harmful to sensitive aquatic species residing in the Dutch Slough Restoration Project vicinity. Responses will vary depending on life stage, organism mobility, and hydrologic conditions during the event (e.g. tidal phase, current velocity, etc.). Native species, including tule perch and prickly sculpin, could be entrained in release waters as they are regular inhabitants of the current project area, associated with the dense submerged aquatic vegetation of Big Break, and are sensitive to increases in temperature. Emigrating salmon smolts would also be adversely affected by warm waters which have been documented to increase mortality to individuals that remain in high temperature waters (Brown 2003). This impact applies to both the Dutch Slough Restoration Project site and the Ironhouse parcel. Since this impact could potentially occur during salmon migrations, thus affecting endangered species, it is considered significant.

OPEN WATER MANAGEMENT OPTIONS

This impact applies to all of the tidal open water management options. Under the two non-tidal management options impacts would occur over a longer time period. These two options do not involve breaching the site to full tidal action at any time in the foreseeable future and thus would require water level management for the lifetime of the Dutch Slough Restoration Project. The impacts for all the above scenarios would be significant.

MITIGATION 3.5.1-2.1: RELEASE ON-SITE WATER GRADUALLY

Water from the Dutch Slough Restoration Project area shall be released gradually to reduce the impact of low DO and high temperature water on the surrounding water body. This would allow the plume of degraded water to dissipate without harmful affects to aquatic life.

MITIGATION 3.5.1-2.2: LIMIT OPERATION DURING MIGRATION PERIODS OF SENSITIVE SPECIES

Water level management activities shall be limited during migration periods for sensitive species such as salmon to reduce the potential impacts upon these species.

MITIGATION 3.5.1-2.3: MAINTAIN SHORT RESIDENCE TIME

Residence time of water shall be limited to reduce the opportunity for adverse water quality conditions to develop. Residence time is controlled by the rate at which water is exchanged between the managed area and its adjacent tidal source. The Dutch Slough Restoration Project shall utilize appropriate water control structures that allow flexibility in management to provide adaptive management capacity.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-3: ENTRAINMENT OF FISH INTO AREAS DISCONNECTED FROM THE BAY-DELTA (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

Entrainment involves the diversion of fish from a water body into habitats that may be unsuitable, or from which they are unable to escape. If fish are diverted into an area isolated from the surrounding water body they may be subject to stressors such as poor water quality (i.e., increased water temperature and low dissolved oxygen) and increased predation pressure from other fish, birds and mammals. Entrainment can also prevent fish from completing important life history events such as spawning and rearing migrations. The significance of entrainment is assessed based on the potential to impede the movement of special status species during critical life history events, or to cause excessive mortality.

Alternative 1 calls for lowering some sections of the surrounding levees to high marsh elevation prior to breaching the site for full tidal exchange. High tides would occasionally overtop these areas, potentially entraining fish inside the site. Water would also be drawn into the site during the revegetation period potentially entraining fish through the intake structures. This impact would apply to the Dutch Slough and Ironhouse projects. Since the Dutch Slough Restoration Project site levees are not expected to be breached until three years after the initial levee construction phase of the Dutch Slough Restoration Project, this impact is considered potentially significant.

OPEN WATER MANAGEMENT OPTIONS

This impact applies to all of the Dutch Slough Restoration Project open water management options. The tidal management options would have short-term periods prior to levee breaching when fish could be entrained. The duration of this impact is relatively short, but as described above it could be three years to breaching. The non-tidal management options would have entrainment impacts over a longer time period. These two options do not involve breaching the site to full tidal action and thus, by design, create possibilities for fish entrainment through intake structures as well as crossing the drainage divides from the restored tidal marsh. Since both the tidal and non-tidal management options would create entrainment hazards for at least three years, the impacts are considered potentially significant.

MITIGATION 3.5.1-3: DEVELOP MEASURES TO MINIMIZE ENTRAINMENT UNDER INCIDENTAL TAKE PERMIT

Implementation of the Dutch Slough Restoration Project may require an incidental take authorization from the USFWS/NOAA Fisheries and the California DFG. This will require monitoring for entrainment during periods of potential presence of listed species. The mitigation plan shall require the identification of measures to avoid and minimize the take of listed species. Potential measures shall include the installation of fish screens on water intake structures based on the criteria of NMFS, USFWS, and DFG, or restricting the operation of such structures during migration periods of listed species.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-4: MERCURY METHYLATION COULD CAUSE BIOACCUMULATION AND TOXICITY TO FISH (DUTCH SLOUGH RESTORATION PROJECT AND IRONHOUSE PROJECT)

As discussed in Chapter 3.2, Impact 3.2.1-4 mercury methylation, is a concern for wetland restoration projects in the Bay-Delta because certain types of wetland habitats are known to support the biological processes that transform mercury into methylmercury (MeHg). Total mercury should not change as a result of the Dutch Slough Restoration Project and Ironhouse Projects (the City's Community Park Project would not affect mercury), however, there could be an increase in MeHg loads to water in Dutch Slough or Big Break, as well as localized increased concentrations of mercury in sediment. A localized increase in MeHg in the immediate vicinity of the Dutch Slough Restoration Project could be a hazard to aquatic organisms regularly inhabiting the area. Since MeHg biomagnifies up the trophic structure, increased amounts of MeHg in the environment could have adverse effects on top predators such as salmonids, striped bass, and largemouth bass in the Dutch Slough vicinity. High levels of MeHg can cause damage to the nervous, reproductive and immune systems.

Certain aquatic habitats are more likely to serve as sources of MeHg than others. Mudflats and irregularly inundated areas such as high marsh zones and flooded bypasses seem to have the highest rates of MeHg export while emergent tidal marshes and open water habitats appear to have the lowest rates of flux, and can even serve as MeHg sinks. More shallow open water and less vegetation means Alternative 1 is likely to yield lower MeHg concentrations than Alternatives 2 and 3. Since the amount of high marsh and mudflat habitat being created would be minimal, the amount of MeHg exported from the Dutch Slough Restoration Project site may be negligible. The width of the 5:1 slope levees and natural transitions to uplands by about 1 ft. vertical range of restored marsh by about 5 miles of edge at most equates to about 3 acres total of high marsh out of 440 to 830 acres of restored marsh depending on alternative. While all of the restored marsh area has some probability of methylating mercury, roughly 0.7% of the restored marsh area is considered high marsh zone, which is the type of marsh anticipated to have the highest MeHg export. For these reasons, this impact is considered less than significant.

The Dutch Slough Project includes monitoring for mercury and MeHg levels in water and sediments in the Dutch Slough vicinity both before and after restoration activities take place. This monitoring will provide baseline conditions at the site and will allow for comparisons between pre and post restoration MeHg levels. The information will aid in determining potential site management changes in the future, as well as advance the general body of knowledge on the subject of MeHg creation and export in restored tidal marshes. It is likely that these monitoring activities will be coordinated with the creation of the Delta Mercury TMDL.

The water-quality monitoring plan also includes monitoring for mercury and MeHg levels in Marsh Creek. Should the study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Ironhouse Parcel as part of that project may not occur.

OPEN WATER MANAGEMENT OPTIONS

Since many of these options are "experimental" it is hard to predict how they will impact MeHg production. The environmental factors that promote the production of MeHg (high organic matter content, low DO, high temperature) would be more enhanced in the skeletal channel network option than in the deep subtidal option. In the non-tidal management options, subsidence reversal would be more likely to promote mercury methylation than managed pond since it would produce high organic matter, low DO, and high temperature conditions. These areas, however, are expected to remain submerged for extended periods with little if any periods of dry, thereby providing conditions that are apparently less likely to produce and export MeHg. Given the existing knowledge base regarding the biogeochemical processes of MeHg and the extremely small areas that would be established that appear more likely to methylate mercury, this impact is considered not significant.

IMPACT SIGNIFICANCE

Less than significant. No mitigation required.

IMPACT 3.5.1-5: DISTURBANCE OF BENTHIC HABITATS

DUTCH SLOUGH RESTORATION PROJECT AND ALL OPEN WATER MANAGEMENT OPTIONS

As previously mentioned, it is possible that the upstream reach of Little Dutch Slough may need to be dredged to allow full tidal drainage in marshes adjacent to it. This action would disrupt the substrate, thus removing the benthic habitat and associated macroinvertebrate community. This action would occur over a short time period, and therefore the impacts should be only temporary. The substrate that would be disturbed should be rapidly recolonized by benthic macroinvertebrates and fish. Therefore, this impact is not expected to be significant.

IMPACT 3.5.1-6: CREATION OF HABITAT THAT BENEFITS NON-NATIVE FISH SPECIES

DUTCH SLOUGH RESTORATION PROJECT

While the goals of the Dutch Slough Restoration Project and Ironhouse Project are to create tidal and freshwater wetland habitats for the benefit of native fishes, there is a chance that the habitats created could favor non-native species (Brown 2003) that prey on native species, thus causing a further decline of some special status species. The fish assemblages found in tidal freshwater wetlands in the Delta are dominated by alien species (Brown 2003). The fish assemblage found in a restored wetland often depends on the type of habitat that is created. Native species are associated more with shallow, intertidal habitats, while deep, subtidal areas tend to support more invasives (Simenstad et al. 2000). Several studies have also investigated the link between invasive submerged aquatic vegetation (SAV) and invasive fish species. The vegetation species of greatest concern is *Egeria densa*, a Brazilian waterweed that forms dense monocultures in shallow waters (Grimaldo and Hymanson 1999). Water hyacinth (*Eichhornia crassipes)* is another highly invasive floating plant in the Sacramento San Joaquin delta. Invasive centrarchid predators (bass and bluegill) are often found in high numbers in *Egeria* beds, as are the native tule perch. The decline in tule perch coupled with the increase in centrarchids in the Delta suggest that there may be interspecific interaction between these species (Nobriga and Chotkowski 2000).

There is a growing body of evidence that shallow habitats dominated by submerged macrophytes are generally unsuitable for the Delta's remnant native fish fauna (Grimaldo et al. 2004; Nobriga and Feyrer 2007; Brown and Michniuk 2007, as cited in Nobriga and Feyrer 2007; Brown 2003; Nobriga et al. 2005). Grimaldo et al. (2004) found very few native fish larvae in macrophyte-dominated habitats, suggesting they are either rarely used as spawning habitats or native fish larvae suffer high mortality when they use submerged macrophytes for spawning. Grimaldo et al. (2004) also found a link between the amount of tidal exchange and exotic fish: in their study, a restored site with minimal tidal exchange and greater lower-trophic productivity supported the highest densities of alien fish. They conclude that the best native fish restoration strategy may be restoring wetlands that offer only winter and spring inundation periods, which may provide maximum benefits to natives while limiting access by many exotic fishes (Grimaldo et al. 2004). Nobriga and Feyrer (2007) state: "We strongly suggest that restoration projects in the Delta need to discourage submerged macrophyte domination".

A recently completed 5-year fish monitoring program at the newly created Decker Island Tidal Marsh restoration site in the Sacramento- San Joaquin estuary (Rockriver 2007) supports the observations that non-native aquatic vegetation enhances non-native fish predator populations. This restoration site, in the Sacramento River near Rio Vista, is composed of several subtidal channels in a dendritic configuration with a single outlet to the Sacramento River. In the 5-years since the project was created, the channels have become invaded by beds of *Egeria* and water hyacinth, and introduced centrachids dominate the restored habitat. Also, large numbers of young-of-the year centrachids indicate that the restoration site is utilized for spawning and rearing. While the vegetation/upland habitat of the project was highly successful, the project has not met 4 out of the 5 aquatic success criteria that were developed to determine habitat value for native fish in the restoration site (Rockriver 2007). The monitoring report concludes by stating that "eliminating or greatly decreasing the amount of SAV and floating vegetation from the restoration site may increase native fish use of the restoration site in the spring. More importantly, it may reduce the number of centrarchids residing in the channel habitats."

Egeria may offer increased foraging resources for some native species through the associated macroinvertebrate community (Brown 2003), but it is unlikely that this benefit outweighs the increased predation pressure from non-native centrarchids and striped bass. The significance of this impact depends on whether the creation of such habitats could lead to more predation upon special status species than currently occurs.

This impact applies mainly to the open-water and subtidal portions of the Dutch Slough Restoration Project. This document assumes that the Dutch Slough Restoration Project's open-water management option would be shallow subtidal with native SAV planting. This option calls for the pre-establishment of native plants and management for invasives. If this is performed effectively then the habitat created should be beneficial for native fish species. However, if invasive plants are allowed to colonize the open water areas, they may create feeding opportunities for invasive fish species at the expense of natives, including target special status species. Because the final outcome of the created aquatic habitat cannot be determined and because of the outcome of the aquatic habitat on Decker Island, the significance of this impact cannot be pre-determined and it will be considered potentially significant.

Open Water Management Options

The skeletal channel network options for open water management also call for the pre-establishment of native SAV and would therefore have the same impacts and significance as the shallow subtidal option; it may, however, lend itself better for control measures to reduce invasive SAV and floating aquatic vegetation (FAV). Additionally, the skeletal channel network would act to separate native fish species from open water habitat colonized by invasive SAV, and also provide superior channel edge habitat thus potentially exceeding the potential impacts of subtidal open water areas compromised by SAV. The deep open water management option would be too deep for the establishment of FAV/SAV. This option would prevent invasive SAV from establishing and taking over the site. However, as noted above, deep open water areas in breached wetland habitats are often dominated by alien fish species

The two non-tidal open water management options for the Dutch Slough Restoration Project, managed pond and subsidence reversal, are not designed for the benefit of fish and the assemblages that develop in the ponds would do so mainly through entrainment. Therefore, these options are not considered to produce any benefit for fish, be they native or alien, and the impacts would not be significant.

Adaptive management techniques would be applied as they become available and information warrants topromote native fish success in open water areas. One avenue that will be investigated, in the event that non-native vegetation and fish predators become dominant in the Dutch Slough Restoration site, is the construction of additional levee breaches to enhance tidal exchange.

Mitigation 3.5.1-6: Enhance tidal exchange.

In the event that non-native vegetation and fish predators become dominant in the Dutch Slough Restoration site, constructing additional levee breaches and other measures to facilitate a greater tidal exchange in the open water areas and subtidal channels to promote habitat favorable to the establishment of native SAV and native fish will be investigated and implemented accordingly.

Impact Significance After Mitigation:

Potentially significant. The problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species may be an unavoidable consequence of habitat restoration.

Impact 3.5.1-7: Endocrine Disrupting Chemicals and Other Contaminants Entering the Site From Marsh Creek or from fill soils Could Harm Fish

Dutch Slough Restoration Project and Open Water Management Options

As described in Section 3.2, Impact 3.2.1-7, endocrine-disrupting chemicals and heavy metals could enter Dutch Slough and Ironhouse restoration project waters via Marsh Creek and fill soils, particularly imported soils from the Ironhouse parcel formerly subjected to spray of treated wastewater, which may have contained these compounds and metals. Some endocrine disruptors that are of particular concern to fish are heavy metals, polyaromatic compounds and steroid estrogens. Metals are known to have a suite of physiological and behavioral effects on fish including organ damage (Baker 1969), delaying or preventing sexual maturation (Edwards and Brown 1967), and inhibiting feeding behavior. Exposure to polyaromatic compounds has been linked to increases in cancerous lesions and tumors and deformities in fish (Vogelbein and Unger 2006, Yang 2005). Steroid estrogens (e.g. estrone (E1), 17-estradiol (E2), 17-ethinylestradiol (EE2)) are responsible for a phenomenon known as "feminization", in which males experience morphological changes in sex organs, or complete sex reversals (Matthiessen and Sumpter 1998, Gomez and Lester 2003).

Recent soil toxicity tests on the Ironhouse parcel indicate no likely adverse effects on water quality if borrow sediment is used. No elevated concentrations were recorded for a suite of potential harmful contaminants (Stellar Environmental Solutions 2006). The results of the soil investigation also indicated that the spatial variation in contaminants was low enough that no further sampling is necessary before soils are excavated and reused.

The EPA has established target concentrations for heavy metals and many polyaromatic hydrocarbons that are not to be exceeded in freshwater environments. These standards can be located through the Water Quality Standards Database (http://www.epa.gov/wqsdatabase/reports_inter.html). There are, however, no established limits for concentrations of estrogenic compounds or many other PPCPs.

There are also other water quality constituents that could be found in Marsh Creek that could be harmful to aquatic life either directly or indirectly. These include hydrocarbons, excessive nutrients from agriculture operations and lawn fertilizers, and pathogens from agricultural operations and municipal wastewater. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations.

This impact would apply mainly to the Ironhouse restoration parcel under the Dutch Slough Restoration Project scenario. Diverting Marsh Creek onto the Dutch Slough Restoration Project site could cause adverse effects by introducing the above listed contaminants directly. The Dutch Slough Restoration Project site would still receive some input of these substances from Marsh Creek even without it being routed directly onto the property since the mouth of the creek is adjacent to the site. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations. There are currently not enough data on the water quality in Marsh Creek to determine with certainty if diversion could lead to significant harm to aquatic resources. The impact is considered potentially significant.

MITIGATION 3.5.1-7.1: MARSH CREEK WATER QUALITY TESTING AND EVALUATE FEASIBILITY OF MARSH CREEK RELOCATION BASED ON WATER QUALITY CONSIDERATIONS

This mitigation will be the same as water quality mitigation 3.2.1-7.1.

MITIGATION 3.2.1-7.2: TIMING OF RELOCATION OF MARSH CREEK

This mitigation will be the same as water quality mitigation 3.2.1-7.2

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.1-8 CUMULATIVE IMPACTS

The Dutch Slough Restoration Project, Ironhouse Project, and City Community Park would be developed in an area that is experiencing rapid urbanization. Several housing developments immediately adjacent to the site are either currently under construction or are scheduled to begin soon. The Ironhouse Sanitary District is planning to expand its sewage treatment capacity from 3.6 million gallons/day (MGD) to 8.0 MGD to accommodate the new housing developments. The ISD also plans to eliminate its land-based wastewater irrigation on the mainland and construct a surface water discharge with tertiary treatment at Jersey Point (on Jersey Island). This is the preferred alternative, although the ISD is also evaluating the possibility of expanding its wastewater irrigation operations on Jersey Island.

These proposed developments could have potential impacts on fishery resources in the Dutch Slough and Ironhouse sites and the greater project vicinity. The new housing developments would increase the human population in the area, leading to more recreation pressure at the site. Specific impacts to fisheries could include increased angling and littering. The increased volume of municipal sewage from the new developments would introduce more pollutants to the waters, which could exacerbate Impact 3.5.1.7 above. The method in which the treated wastewater is discharged would determine the severity of the impact to aquatic organisms. More pollutants could potentially be introduced to the site if the effluent is discharged to surface waters as opposed to being used for irrigation on Jersey Island. However, the point of surface water discharge is planned to be located at Jersey Point on the San Joaquin River, which is on the opposite side of Jersey Island from the Dutch Slough Restoration Project site. This will allow pollutants to be diluted and dispersed before they reach the site, thus reducing their potential impact on aquatic life. The aquatic resources in Gallagher Slough (across the San Joaquin River from Jersey Point) and potentially Big Break and Franks Tract would be more severely impacted.

There is also a proposal to encase nearly four miles of the Contra Costa Canal including a section of the Canal in the vicinity of Dutch Slough. The encasement of this waterway would eliminate any fishery resources currently in the canal. However, that project calls for fish relocation efforts prior to construction, which should mitigate that impact.

The impacts to aquatic resources due to potential sea level rise also must be considered. A variety of estimates quantify the range of potential sea level rise, report observed trends and offer predictions of global warming and the potential impacts (IPCC 2001, CCCC 2006). The Intergovernmental Panel on Climate Change reports that over the last 100 years the eustatic (globally averaged) sea level rise was 1to 2 mm/year (0.3 to 0.6 ft/century). The IPCC projects rates of sea level rise to increase over the next century, with projected increases ranging from 0.4 - 2.9 ft by 2100 (IPCC 2001). More recent estimates by the California Climate Change Center[1] report sea level rise in California over the past century to be approximately 7 inches (0.6 ft), and projects increases of 22 to 35 inches (1.8 to 2.9 ft) by 2100 (CCCC 2006). As described in Chapter 3.1, Hydrology, CALFED scientists have projected possible greater sea level rises, ranging from 29-78 inches this century.

Rise in sea level would affect fish primarily by changing the availability of habitat. In the Dutch Slough Restoration Project site, a rise in sea level would cause marsh areas to become shallow open water habitat, and open water areas to become even deeper. This could effectively eliminate the marsh habitat being created by the restoration project unless natural sediment accretion is able to keep up with the rate of sea level rise.

Alternative 2: Moderate Fill Alternative

IMPACT 3.5.2-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES

DUTCH SLOUGH RESTORATION PROJECT AND OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as Impact 3.5.1-1.

MARSH CREEK RELOCATION OPTIONS

All options for relocating Marsh Creek would require the construction of an earthen blockage in the existing channel to route the creek onto the Emerson parcel. The creation of this structure could lead to an increased sediment and construction contaminant load to the creek and the adjoining Bay-Delta. This impact is considered to be potentially significant.

MITIGATIONS

Mitigations will be the same as for Impact 3.5.1-1. Along with installing coffer dams around levee breach locations (Mitigation 3.5.1-1.3), these structures shall be installed around the area where the Marsh Creek channel blockage is to be constructed to reduce sediment and contaminant loading to the Bay-Delta.

SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.2-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING REVEGETATION PERIOD

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as Impact 3.5.1-.2, except that there is less open water area in this alternative, resulting in a lower volume of water to be managed.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as 3.5.1-2 except that the volume of water would be less.

MARSH CREEK RELOCATION OPTIONS

Not applicable

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-2.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigations.

IMPACT 3.5.2-3: ENTRAINMENT OF FISH INTO AREAS DISCONNECTED FROM THE BAY-DELTA

Impacts and mitigations would be the same as for Impact 3.5.1-3 (all options).

IMPACT 3.5.2-4: MERCURY METHYLATION COULD CAUSE BIOACCUMULATION AND TOXICITY TO FISH

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as for Impact 3.5.1-4.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as for Impact 3.5.1-4.

MARSH CREEK RELOCATION OPTIONS

Diverting Marsh Creek to the project area could cause mercury deposition in marsh and open water areas, especially in Ironhouse or Emerson parcels (depending on design), to the extent that mercury is present in waters and suspended sediments in Marsh Creek. Loads of total mercury to marsh areas could slightly increase MeHg production.

The Dutch Slough Project includes monitoring for mercury and MeHg levels in Marsh Creek. Should the study find that mercury levels are outside the acceptable range, diverting Marsh Creek onto the Emerson Parcel may not occur.

IMPACT SIGNIFICANCE

Less than significant.

IMPACT 3.5.2-5: DESTRUCTION OF BENTHIC HABITATS

DUTCH SLOUGH RESTORATION PROJECT

The impact will be the same as Impact 3.5.1-5.

OPEN WATER MANAGEMENT OPTIONS

The impact will be the same as Impact 3.5.1-5.

MARSH CREEK RELOCATION OPTIONS

All three options for Marsh Creek relocation involve the creation of a channel block which would eliminate benthic habitat within the block's footprint. However, the creek would be routed into the Dutch Slough Restoration Project site via a newly dredged channel, which would ultimately create more habitat for these organisms. As long as the construction and dredging activities for Marsh Creek are performed outside of migration and or spawning periods for special status species, the impact would not be significant and would require no mitigation.

IMPACT SIGNIFICANCE

Less than significant.

IMPACT 3.5.2-6: CREATION OF HABITAT THAT BENEFITS NON-NATIVE FISH SPECIES

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as for Impact 3.5.1-6. The total area of open water in Alternative 2 would be less than that in Alternative 1, which would result in less area that must be managed for invasive FAV/SAV.

OPEN WATER MANAGEMENT OPTIONS

The impact would be the same as Impact 3.5.1-6, except that the total area of open water would be less in this alternative. Less area would need to be managed for invasive FAV/SAV under the skeletal network option. Under the deep subtidal management option there would be less open water habitat for alien fish species to colonize. The non-tidal management options also would be the same as in Alternative 1, only with a smaller area for alien fish species to colonize.

MARSH CREEK RELOCATION OPTIONS

Not applicable

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-6.

IMPACT SIGNIFICANCE AFTER MITIGATION

Potentially significant and unmitigable. However, the problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species is an unavoidable consequence of habitat restoration.

IMPACT 3.5.2-7: ENDOCRINE DISRUPTING CHEMICALS AND OTHER CONTAMINANTS ENTERING THE SITE FROM MARSH CREEK OR FROM FILL SOILS COULD HARM FISH

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as 3.5.1-7, except in this alternative, soils from the Ironhouse Parcel would be used as fill material on the Dutch Slough Site.

OPEN WATER MANAGEMENT OPTIONS

Not applicable

MARSH CREEK RELOCATION OPTIONS

Diverting Marsh Creek onto the Dutch Slough Restoration Project site could cause adverse effects by introducing the above-listed contaminants from urban runoff, agricultural operations, and wastewater treatment effluent. These pollutants could cause harm to fish and macroinvertebrates if they are found in high enough concentrations. There are currently not enough data on the water quality in Marsh Creek to make a decision if diversion could lead to harm to aquatic resources. The Dutch Slough Restoration Project intends to collect more data on this topic. Until that time it is not possible to determine the potential significance of this impact and, for the purposes of this EIR, it is considered potentially significant.

MITIGATIONS

Mitigations would be the same as for Impact 3.5.1-7. If water quality is found to be below allowable standards, the routing of Marsh Creek onto the Dutch Slough Site would be eliminated.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation.

IMPACT 3.5.2-8 CUMULATIVE IMPACTS

Same as Alternative 1.

Alternative 3: Maximum Fill

IMPACT 3.5.3-1: DECREASED WATER QUALITY DUE TO CONSTRUCTION/DREDGING ACTIVITIES

DUTCH SLOUGH RESTORATION PROJECT

The impact would be similar to Impact 3.5.1-1 but reduced because there would be no need to dredge Little Dutch Slough.

OPEN WATER MANAGEMENT OPTIONS

Not applicable

MARSH CREEK RELOCATION OPTIONS

The impact would be the same as Impact 3.5.2-1.

MITIGATION

Mitigations would be the same as for Impact 3.5.2-1.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.3-2: RELEASE OF LOW QUALITY WATER FROM PROJECT AREA DURING REVEGETATION PERIOD

DUTCH SLOUGH RESTORATION PROJECT

The impact would be the same as Impact 3.5.1-2 except that only the Emerson parcel would have an open water area, resulting in the smallest volume of water of all three alternatives.

Open Water Management Options

The impact would be the same as Impact 3.5.1-2 except only the Emerson parcel would have an open water area.

Marsh Creek Relocation Options

Not applicable

Mitigations

Mitigations would be the same as for Impact 3.5.1-2.

Impact Significance After Mitigation

Less than significant with mitigation

Impact 3.5.3-3: Entrainment of Fish Into Areas Disconnected From the Bay-Delta

Dutch Slough Restoration Project

The impact would be the same as Impact 3.5.1-3; however the impacts would be less intense because the Emerson parcel is the only parcel that is designed to have open water areas.

Open Water Management Options

The impact would be the same as Impact 3.5.1-3, however the impacts would be less intense because the Emerson parcel is the only parcel that is designed to have open water areas.

Marsh Creek Relocation Options

Not applicable

Mitigation

This would be the same as Mitigation 3.5.1-3

Impact Significance After Mitigation

Not significant with mitigation

Impact 3.5.3-4: Mercury Methylation Could Cause Bioaccumulation and Toxicity to Fish

Dutch Slough Restoration Project and Open Water Management Options

Impacts would be the same as for Impact 3.5.2-4 (all options).

Marsh Creek Delta Relocation Options

Same as Impact 3.5.2-4

Impact 3.5.3-5: Destruction of Benthic Habitats

Dutch Slough Restoration Project

Alternative 3 would not include dredging Little Dutch Slough, which would eliminate the destruction of the benthos in this area.

Open Water Management Options

Not applicable

Marsh Creek Relocation Options

The impact would be the same as Impact 3.5.2-5

Impact Significance

Not significant

Impact 3.5.3-6: Creation of Habitat That Benefits Non-Native Fish Species

Dutch Slough Restoration Project

The impact would be similar to Impact 3.5.1-6. However, since this alternative calls for the creation of the least amount of open water habitat (on the Emerson parcel only), the potential negative impacts on native fishes should be the least of the three alternatives.

Open Water Management Options

The impact would be similar to Impact 3.5.1-6. However, this alternative would involve the least amount of area that must be managed for invasive FAV/SAV under the skeletal network options. Under the deep subtidal management option there would be less open water habitat for alien fish species to colonize.

Marsh Creek Relocation Options

Not applicable

Mitigations

Mitigations would be the same as for Impact 3.5.1-6

Impact Significance After Mitigation

Potentially significant. However, the problems caused by non-native fishes are ubiquitous throughout the Delta and the subsequent invasion of the site by these species is an unavoidable consequence of habitat restoration.

IMPACT 3.5.3-7: ENDOCRINE DISRUPTING CHEMICALS AND OTHER CONTAMINANTS ENTERING THE SITE FROM MARSH CREEK OR FROM FILL SOILS COULD HARM FISH

Impacts and mitigations would be the same as for Impact 3.5.2-7 (all options).

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant with mitigation

IMPACT 3.5.3-8 CUMULATIVE IMPACTS

Same as Alternative 1.

Alternative 4: No Project

Under the no-project alternative there are several possible scenarios of future land use, including management for non-tidal wetland habitat, conversion to a recreational park, or residential and commercial development. In all of these situations the levees will continue to be maintained.

IMPACT 3.5.4-1: REDUCED WATER QUALITY DUE TO LEVEE REPAIR ACTIVITIES

Without the Dutch Slough Restoration Project, the levees surrounding the Dutch Slough Restoration Project site would continue to be subject to wind-wave erosion, resulting in occasional levee failures/breaches. Repairing these breaches would result in construction activities that could cause temporary localized increases in suspended sediments and the possible introduction of contaminants (fuel oils, grease, etc) from construction equipment.

MITIGATION 3.5.4-1: FOLLOW SWPPP AND BMPS DURING LEVEE MAINTENANCE AND REPAIR

Levee maintenance activities shall follow accepted practices for levee maintenance and repair according to existing and future permits held by the Reclamation District from the U.S. Army Corps of Engineers and Regional Water Quality Control Board.

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant

IMPACT 3.5.4-2: ENTRAINMENT OF FISH INSIDE THE DUTCH SLOUGH RESTORATION PROJECT SITE THROUGH UNINTENDED LEVEE BREACHES OR OVERTOPPING

Should levee breaches or overtopping occur, it is possible that fish from the surrounding Bay-Delta could be diverted onto the Dutch Slough Restoration Project site and into subsided areas that they are unable to escape from.

MITIGATION 3.5.4-2: MAINTAIN LEVEES TO MINIMIZE POTENTIAL FOR OVERTOPPING AND BREACHING

Continue active maintenance and repair of levees so as to minimize the potential that levee overtopping or unintended breaches could occur. Follow all regulatory requirements (see Impact 3.5.4-1).

IMPACT SIGNIFICANCE AFTER MITIGATION

Less than significant.

Table 3.5-2: Summary of Aquatic Resources Impacts for Dutch Slough Restoration Project and Related Projects

	Impact No.	Impact	Dutch Slough Restoration Project	Related Projects	
				Ironhouse Project	City Community Park Project
Alternatives 1, 2, and 3	3.5.1-1	Decreased water quality due to construction/dredging activities	X	X	X
	3.5.1-2	Release of low quality water from project area during pre-breach water management periods	X	X	
	3.5.1-3	Entrainment of fish into areas disconnected from the Bay-Delta	X	X	
	3.5.1-4	Mercury Methylation could cause bioaccumulation and toxicity to fish	X	X	
	3.5.1-5	Destruction of Benthic Habitats	X		
	3.5.1-6	Creation of habitat that benefits non-native fish species	X		
	3.5.1-7	Endocrine disrupting chemicals and other contaminants entering the site from Marsh Creek or from fill soils could harm fish	X	X	
	3.5.4-1	Reduced water quality due to levee repair activities	X	X	
Alternative 4 (No Project Alternative)	3.5.4-2	Entrainment of fish inside the Dutch Slough Restoration Project site through unintended levee breaches or overtopping	X		

Table 3.5-3: Summary of Mitigation Applicability for Dutch Slough Restoration Project and Related Projects

	Mitigation	Dutch Slough Restoration Project	Related Projects	
			Ironhouse Project	City Community Park Project
Alternatives 1, 2 and 3	Mitigation 3.5.1-1.1: Develop A SWPPP through the RWQCB	X	X	X
	Mitigation 3.5.1-1.2: Limit construction to the dry weather season	X	X	X
	Mitigation 3.5.1-1.3: Install coffer dams	X	X	
	Mitigation 3.5.1-2.1: Release on-site water gradually	X	X	
	Mitigation 3.5.1-2.2: Limit operation during migration periods of sensitive species	X	X	
	Mitigation 3.5.1-2.3: Maintain short residence time	X	X	
	Mitigation 3.5.1-3: Develop measures to minimize entrainment under incidental take permit	X	X	
	Mitigation 3.5.1-4: Monitor mercury and methylmercury concentrations in the project area and implement identified reduction strategies	X	X	
	Mitigation 3.5.1-6: Enhance tidal exchange	X	X	
	Mitigation 3.5.1-7-2: Timing of relocation of Marsh Creek	X	X	
Alt. 4 No Project	Mitigation 3.5.4-1: Follow SWPPP and BMPs during levee maintenance and repair	X	X	
	Mitigation 3.5.4.-2: Maintain levees to minimize potential for overtopping and breaching	X	X	